(d) internal energy as the sum of the random distribution of kinetic and potential energies associated with the molecules of a system

(e) absolute zero (0 K) as the lowest limit for temperature; the temperature at which a substance has minimum internal energy

(f) increase in the internal energy of a body as its temperature rises

(g) changes in the internal energy of a substance during change of phase; constant temperature during change of phase.

(6) M - Define internal energy and absolute zero
(7) S - State and explain the factors that affect internal energy
(8) C - Describe and explain changes in internal energy during changes of phase

Lesson 3. Internal energy

STARTER: How could you find the total energy of the potato?

Kilo 10^3
Mega 10^6
Giga 10^9

How is the total energy of the potato changing?

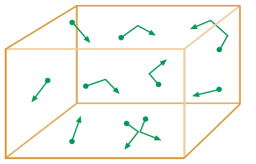
Key point

(6) M - Define internal energy and absolute zero
(7) S - State and explain the factors that affect internal energy
(8) C - Describe and explain changes in internal energy during changes of phase

0:00:00

Key point

Internal energy: The sum of **randomly** distributed **kinetic** and **potential** energies of the **atoms or molecules** within a substance.



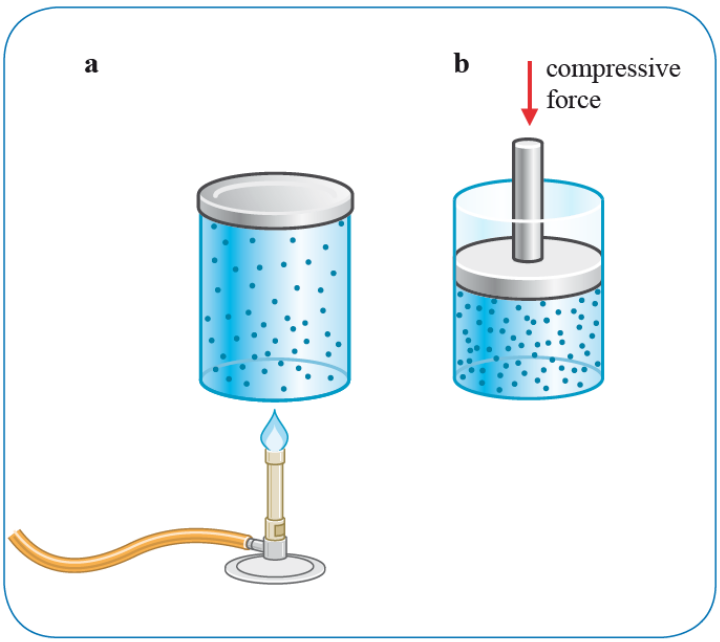
1. How would you go about finding the internal energy of the gas in the box?
2. How could you increase the internal energy of the gas?
3. How could you allow this substance to reach absolute zero? How do you define it?

Key point

Absolute zero is the temperature at which the internal energy of a substance is **minimum.**

Explain ' minimum'

1. Simply add the KE of each of the 10 particles + the PE of each of the 10 particles **SA**
2. Heating it (increase temperature) / doing work on it (a and b)
3. Allow all particles to reach zero v / zero KE.



Ex: How do a) and b) increase the internal energy of the gas?

(6) M - Define internal energy and absolute zero
(7) S - State and explain the factors that affect internal energy
(8) C - Describe and explain changes in internal energy during changes of phase

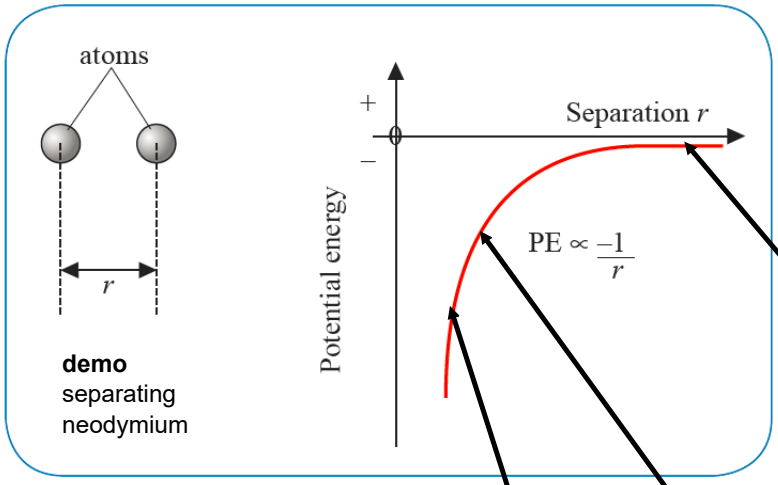
Explaining potential energy

Key point

Molecules or atoms of a substance have potential energy due to the **electrostatic forces of attraction** that exist between them.

This PE depends upon the separation of molecules.

Activity: Use the graph to compare the PE of molecules of solid, liquid and gas.



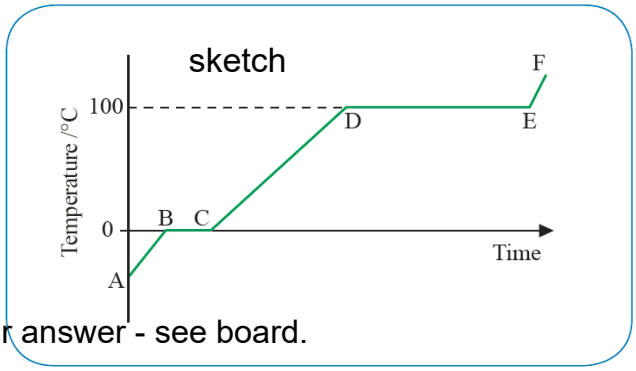
- ~~Electrical PE of 2 atoms close together is large and~~ **negative (solid)**
- Electrical PE increases with increasing separation
- When atoms are completly separated, PE is a maximum and = zero (Gas)

(6) M - Define internal energy and absolute zero
(7) S - State and explain the factors that affect internal energy
(8) C - Describe and explain changes in internal energy during changes of phase

0:00:00

Internal energy during changes of state

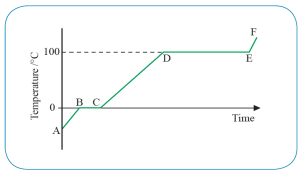
Activity: Describe and explain the changes in; internal energy, KE and PE during each region, as the ice is heated.



Kilo 10^3 Use a grid to structure your answer - see board.

Mega 10^6 Write the Q and highlight the key info/ command words

Giga 10^9 Try to use the word 'negligible' appropriately in your answer



SA

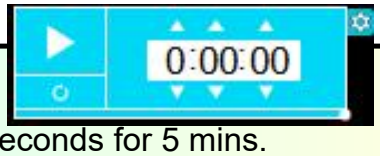
AB
- Internal energy increasing.
- KE increases (as temp increases)
- PE constant as in solid negligible change in separation

BC
- Internal energy increasing.
- KE constant (as temp constant)
- PE increasing as solid melts to liquid increasing separation

CD
- Internal energy increasing.
- KE increasing (as temp increasing)
- PE constant as in liquid negligible change in separation

DE
- Internal energy increasing.
- KE constant (as temp constant)
- PE increasing as evaporation takes place - work is done to separate the particles from bonds

(6) M - Define internal energy and absolute zero
(7) S - State and explain the factors that affect internal energy
(8) C - Describe and explain changes in internal energy during changes of phase

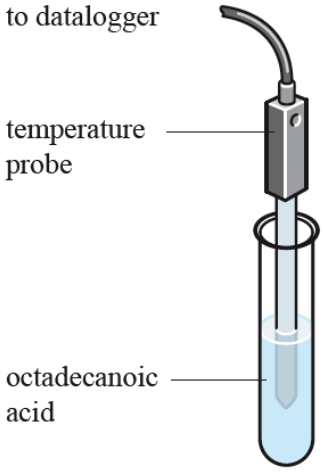


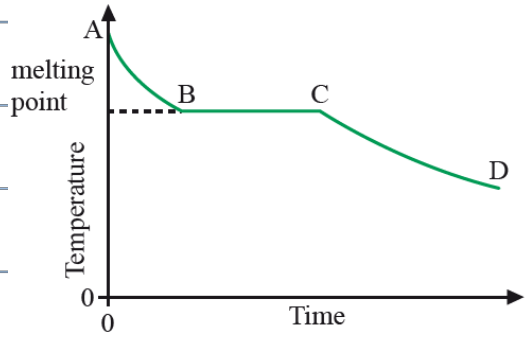
Demonstration: Internal energy

Measure the temperature of the salol every 30 seconds for 5 mins.
Record you results in a table. Plot a graph.

Activity: Explain the constant temperature during the change in state.

Ex: When is the salol is thermal equilibrium? Justify your answer.





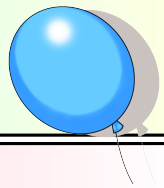
SA

1. Phase change from liquid to solid (freezing)
2. Temperature constant therefor particle KE constant.
3. Particle separation decreased.
4. electrical PE decreases
5. this energy is released as thermal energy.
6. for substance: net thermal energy radiated = PE decrease

(6) M - Define internal energy and absolute zero
(7) S - State and explain the factors that affect internal energy
(8) C - Describe and explain changes in internal energy during changes of phase

0:00:00

Plenary: Complete the question about internal energy



Kilo 10^3 Use your notes to help you

Mega 10^6

Giga 10^9

Key point

2 Gallium has a melting point of 30 °C. Figure 1 shows how the temperature, T, of a small mass of gallium varies when it is heated at a steady rate from 20 °C to 40 °C.

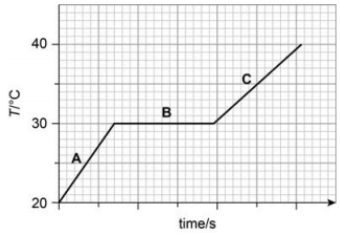


Figure 1

The graph shows three distinct sections labelled **A**, **B**, and **C**.

Describe and explain the features of the graph in terms of the changes which occur to the separation and speed of the molecules and to their internal energy.

.....

.....

.....

.....

.....

.....

..... (*7 marks*)

PA Peer assess using MS.....

Region A:

Speed/KE increases with T/in solid phase — B1

Separation/PE remains constant or increases very slightly — B1

Region B

Speed/KE remains constant as T is constant — B1

Separation/PE increases greatly; as change of phase from solid to liquid occurs — B1

Region C — B1

Speed/KE increases with temperature; in liquid phase — B1

Separation/PE remains constant — B1

Internal energy increases throughout

2 Gallium has a melting point of 30 °C. Figure 1 shows how the temperature, T, of a small mass of gallium varies when it is heated at a steady rate from 20 °C to 40 °C.

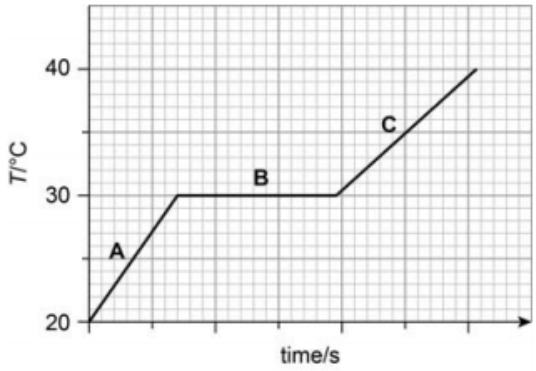


Figure 1

The graph shows three distinct sections labelled **A**, **B**, and **C**.

Describe and explain the features of the graph in terms of the changes which occur to the separation and speed of the molecules and to their internal energy.

.....

.....

.....

.....

.....

.....

..... *(7 marks)*